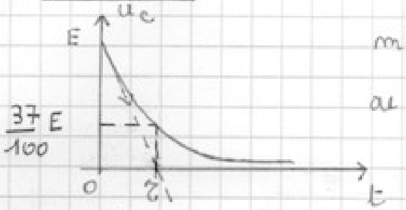
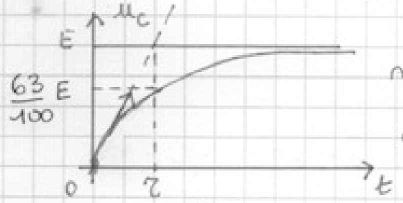
Test régime transitoire — Sujet A

1 $\boxed{\tau = RC}$

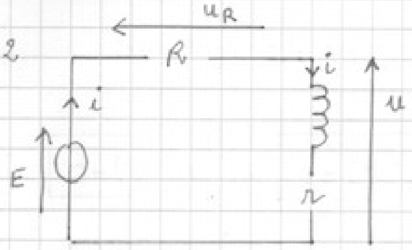


méthode de la tangente à l'origine.
ou méthode des 37%.



méthode de la tangente à l'origine
ou méthode des 63%.

2



a. D'après la loi des mailles :

$u_R + u - E = 0 \qquad u_R + u = E$

$Ri + L\frac{di}{dt} + ri = E$

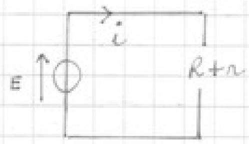
$L\frac{di}{dt} + (R+r)i = E$

b Forme canonique : $\frac{di}{dt} + \frac{R+r}{L} i = \frac{E}{L}$

c. $\boxed{i(0^-) = 0}$ K ouvert

$i(0^-) = i(0^+)$ continuité du courant dans la bobine $\rightarrow \boxed{i(0^+) = 0}$

$i(\infty)$ régime permanent



$\boxed{i(\infty) = \frac{E}{R+r}}$

d $\frac{di}{dt} + \frac{1}{\tau} i = \frac{E}{L} \qquad \tau = \frac{L}{R+r}$

SP $\frac{di_{SP}}{dt} = 0 \qquad \frac{1}{\tau} i_{SP} = \frac{E}{L} \rightarrow i_{SP} = \frac{E\tau}{L} = \frac{E\cancel{L}}{\cancel{L}(R+r)} = \frac{E}{R+r} = i(\infty)$

SH i_{SH} est solution de $\frac{di}{dt} + \frac{i}{\tau} = 0$, il s'agit donc de $i_{SH} = Ae^{-t/\tau}$

SG : $i(t) = i_{SH} + i_{SP} = \frac{E}{R+r} + Ae^{-t/\tau}$

C.I. $i(t=0) = \frac{E}{R+r} + Ae^{-0/\tau} = \frac{E}{R+r} + A$ or $i(t=0) = 0 \Rightarrow \frac{E}{R+r} + A = 0$

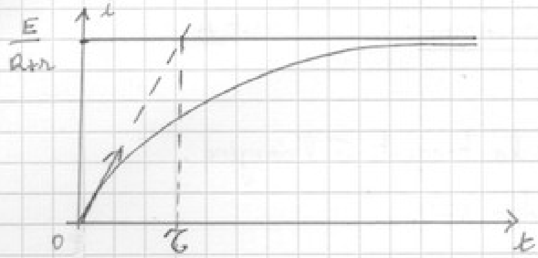
SG : $i(t) = i_{SH} + i_{SP} = \frac{E}{R+r} + Ae^{-t/\tau}$

C.I. $i(t=0) = \frac{E}{R+r} + Ae^{-0/\tau} = \frac{E}{R+r} + A$ or $i(t=0) = 0 \Rightarrow \frac{E}{R+r} + A = 0$

$A = -\frac{E}{R+r} \qquad \boxed{i(t) = \frac{E}{R+r}\left(1 - e^{-t/\tau}\right)}$

$u(t) = E - u_R(t) = E - Ri(t) = E - \frac{RE}{R+r}\left(1 - e^{-t/\tau}\right) = \frac{rE + \cancel{RE} - \cancel{RE} - ERe^{-t/\tau}}{R+r}$

$\boxed{u(t) = \frac{E}{R+r}\left(r - Re^{-t/\tau}\right)}$

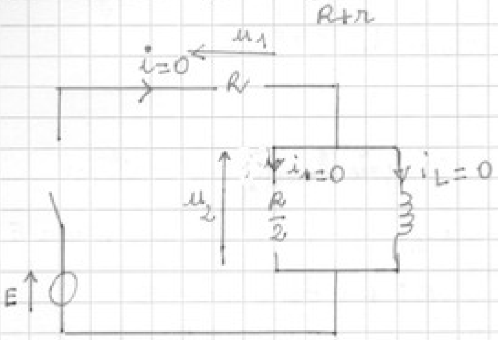


$$i(t) = \frac{E}{R+r}\left(1 - e^{-t/\tau}\right)$$

g) Energie dans la bobine $E = \frac{1}{2} L\, i^2(\infty) = \frac{1}{2} L \frac{E^2}{(R+r)^2}$

h) Au bout de 5τ soit $\frac{5L}{R+r}$

3 a) 0^-



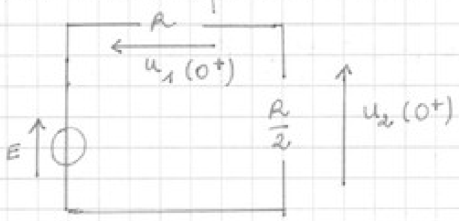
$u_1(0^-) = R\,i(0^-) = 0$

$u_2(0^-) = \frac{R}{2}\, i_1(0^-) = 0$

$\boxed{u_1(0^-) = 0}$ et $\boxed{u_2(0^-) = 0}$

$i_L(0^-) = 0$ or $i_L(0^-) = i_L(0^+)$ continuité du courant dans la bobine.

$\rightarrow i_L(0^+) = 0$ d'où le circuit équivalent à $t = 0^+$

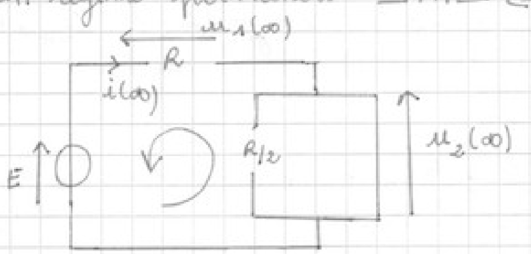


$$u_1(0^+) = \frac{R}{R + \frac{R}{2}} E = \frac{2\cancel{R}}{3\cancel{R}} E$$

$$\boxed{u_1(0^+) = \frac{2}{3} E}$$

$$u_2(0^+) = \frac{\frac{R}{2}}{R + \frac{R}{2}} E = \frac{R}{3R} E \qquad \boxed{u_2(0^+) = \frac{E}{3}}$$

b) En régime permanent — $\Leftrightarrow$ —



$\boxed{u_2(\infty) = 0}$ tension aux bornes d'un fil.

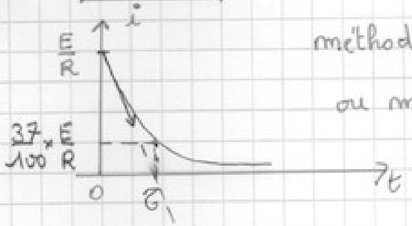
Loi des mailles : $\cancel{u_2(\infty)} + u_1(\infty) - E = 0$

$u_1(\infty) - E = 0$

$\boxed{u_1(\infty) = E}$

Test régime transitoire — Sujet B

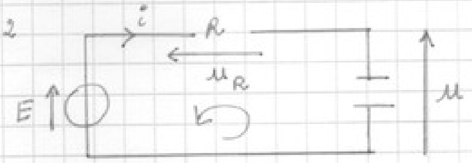
1 $\boxed{\tau = \frac{L}{R}}$



méthode de la tangente

ou méthode des 37%.

2



a. Loi des mailles: $u + u_R - E = 0$

$u + u_R = E$

$u + Ri = E$ avec $i = C\frac{du}{dt}$

$u + R\times\left(C\frac{du}{dt}\right) = E$ $\qquad$ $u + RC\frac{du}{dt} = E$

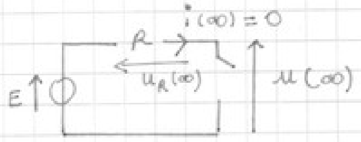
b Forme canonique: $\frac{du}{dt} + \frac{u}{RC} = \frac{E}{RC}$ $\qquad$ $\frac{du}{dt} + \frac{u}{\tau} = \frac{E}{\tau}$

c $\boxed{u(0^-) = 0}$ car le condensateur est déchargé initialement.

$u(0^-) = u(0^+)$ Continuité de la tension aux bornes du condensateur.

$\boxed{u(0^+) = 0}$

$\boxed{u(\infty) = E}$ car ⊣⊢ ⇔ —/—



$u_R(\infty) = 0$

$u(\infty) + \cancel{u_R(\infty)} = E$

d. $\frac{du}{dt} + \frac{u}{\tau} = \frac{E}{\tau}$.

SP $\quad \frac{du_{SP}}{dt} = 0 \qquad \frac{u_{SP}}{\tau} = \frac{E}{\tau} \rightarrow u_{SP} = E$

SH $\quad u_{SH}$ est solution de $\frac{du_{SH}}{dt} + \frac{u_{SH}}{\tau} = 0 \rightarrow u_{SH} = Ae^{-\frac{t}{\tau}}$

SG $\quad u(t) = u_{SP} + u_{SH}(t) = E + Ae^{-t/\tau}$

C.I. : $u(t=0) = 0 \qquad E + Ae^{-0/\tau} = E + A = 0 \rightarrow A = -E$

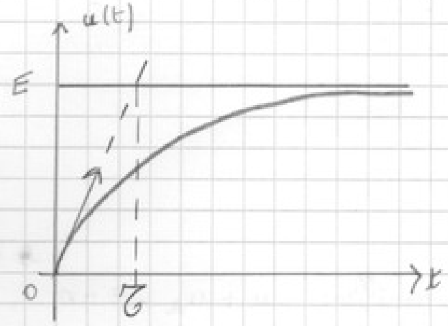
e) $\boxed{u(t) = E\left(1 - e^{-t/\tau}\right)}$

$i = C\frac{du}{dt} = C\frac{d}{dt}\left(E - Ee^{-t/\tau}\right) = C\times\left(0 + \frac{E}{\tau}e^{-t/\tau}\right) = \frac{\cancel{C}E}{R\cancel{C}}e^{-t/\tau}$

$\boxed{i(t) = \frac{E}{R}e^{-t/\tau}}$ $\qquad$ Autre méthode $E = u_R + u = Ri + u \rightarrow i = \frac{E - u}{R}$

$$i(t) = \frac{E - E(1 - e^{-t/\tau})}{R} = \frac{\cancel{E} - \cancel{E} + Ee^{-t/\tau}}{R} \qquad i(t) = \frac{E}{R} e^{-t/\tau}$$

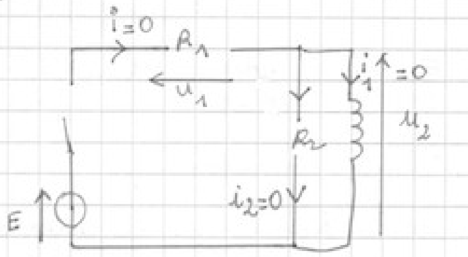
f)



g) $E = \frac{1}{2} C u^2(\infty) = \frac{1}{2} C E^2$

h) Au bout de $5\tau = 5RC$

3 0^-



$i(0^-) = 0$ car K ouvert.

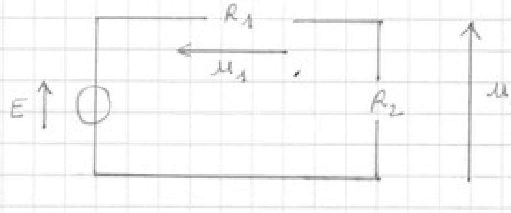
$u_1(0^-) = R_1 \, i(0^-) = 0$

$$\boxed{u_1(0^-) = 0}$$

$u_2(0^-) = R_2 \, i_2(0^-) = 0$

$$\boxed{u_2(0^-) = 0}$$

$i_1(0^-) = i_1(0^+)$ continuité du courant dans la bobine.

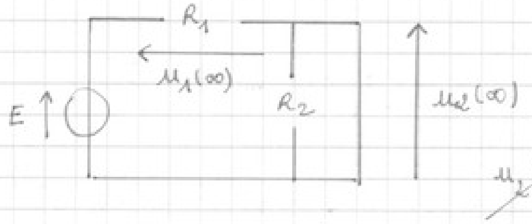


$i_1(0^+) = 0$

$$\boxed{u_2(0^+) = \frac{R_2}{R_1 + R_2} E}$$

$$\boxed{u_1(0^+) = \frac{R_1}{R_1 + R_2} E}$$

$t \to \infty$ régime permanent



$\boxed{u_2(\infty) = 0}$ tension aux bornes d'un fil.

$\cancel{u_2(\infty)} + u_1(\infty) = E$ loi des mailles

$$\boxed{u_1(\infty) = E}$$